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Characterization of Municipal Solid Waste in the United States 1960-2000 (Update 1988)

Franklin Associates Ltd., Prairie Village, KS

Prepared for

Environmental Protection Agency, Washington, DC

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Characterization of Municipal Solid Waste in the United States, 1960 to 2000 (Update 1988)

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PREFACE

This report is an update of Chapter 1 of the 1986 report, Characterization of Municipal Solid Waste in the United States, 1960 to 2000. Both reports were prepared for the U.S. Environmental Protection Agency as part of the RCRA Subtitle D report effort. Gerri Dorian was EPA's project manager.

Franklin Associates project manager was Marjorie A. Franklin, who also was the principal author. Staff support was provided by Nicholas S. Artz, Jacob E. Beachey, Veronica R. Sellers, and Katherine L. Totten.

This work was performed under subcontract to NUS Corporation, EPA Contract No. 68-01-7310, Work Assignment 65. Gary Galida was NUS' project manager.

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CHARACTERIZATION OF MUNICIPAL SOLID WASTE IN THE UNITED STATES, 1960 TO 2000 UPDATE 1988

SUMMARY

Knowledge of the quantities and composition of municipal solid waste (MSW) is a necessary tool for many aspects of solid waste management. This report, which is an update of previous work in 1986, presents a summary of estimates of historical MSW quantities and composition from 1960 to 1986, with projections to the year 2000.

The material flows methodology developed by EPA in the early 1970s, with refinements that have been added in succeeding years, was used to make these estimates.

MATERIALS AND PRODUCTS IN THE MUNICIPAL WASTE STREAM

The quantities of the various materials that make up the municipal waste stream do not increase (or decrease) at the same rate. Table S-1 illustrates the changing composition of MSW over time. (MSW discards in this table are those remaining after materials recovery has taken place.) Paper and plastics materials have been increasing more rapidly than the other components of the waste stream. Glass, ferrous metals, rubber, and other materials have been increasing more slowly or even declining.

Products in the municipal waste stream were characterized in detail and grouped as durable goods, nondurable goods, containers and packaging, and other wastes. Table S-2 illustrates trends in product discards after materials recovery has taken place.

Durable goods, which are increasing rather slowly in the waste stream, include large appliances, furniture, tires, and other miscellaneous items. Nondurable goods are growing more rapidly. Paper products in this category, especially office paper and printing papers, have been growing more rapidly than most other products. Plastic products in this category have also been increasing.

Containers and packaging as a percentage of MSW have been showing a declining trend in recent years. This is caused by the increasing use of relatively lightweight aluminum and plastics and decreasing use of heavier steel and glass containers.

Table S-1

MATERIALS DISCARDED INTO THE MUNICIPAL WASTE STREAM*
(In millions of tons and percent)

Materials	1970		1986		2000	
	tons	%	tons	%	tons	%
Paper and Paperboard	36.5	32.4	50.1	35.6	66.0	39.1
Glass	12.5	11.1	11.8	8.4	12.0	7.1
Metals	13.5	12.0	12.6	8.9	14.4	8.5
Plastics	3.0	2.7	10.3	7.3	15.6	9.2
Rubber and Leather	3.0	2.7	3.9	2.8	3.8	2.3
Textiles	2.0	1.8	2.8	2.0	3.3	2.0
Wood	4.0	3.6	5.8	4.1	6.1	3.6
Other	0.1	-	0.1	-	0.1	-
Food Wastes	12.8	11.4	12.5	8.9	12.3	7.3
Yard Wastes	23.2	20.6	28.3	20.1	32.0	19.0
Miscellaneous Inorganics	1.9	1.7	2.6	1.8	3.2	1.9
TOTALS	112.5	100.0	140.8	100.0	168.8	100.0

* Wastes discarded after materials recovery and before energy recovery.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Table S-2

PRODUCTS DISCARDED INTO THE MUNICIPAL WASTE STREAM*
(In millions of tons and percent)

Products	1970		1986		2000	
	tons	%	tons	%	tons	%
Durable Goods	13.9	12.4	19.2	13.6	23.0	13.6
Nondurable Goods	21.4	19.0	35.4	25.1	47.5	28.1
Containers and Packaging	39.3	34.9	42.7	30.3	50.7	30.0
Other Wastes	37.8	33.6	43.4	30.8	47.5	28.1
TOTALS	112.5	100.0	140.8	100.0	168.8	100.0

* Wastes discarded after materials recovery and before energy recovery.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

The "Other Wastes" category includes food wastes, yard wastes, and other miscellaneous inorganic wastes. This category has been slowly increasing in tonnage, but decreasing as a percentage of total discards.

For this updated report, tables have been added to show the effect of materials and energy recovery on gross discards. (The previous tables showed net discards after materials recovery.) Table S-3 and Figure S-1 show these trends. While gross discards of MSW are increasing, materials and energy recovery have the effect of keeping the wastes to be landfilled relatively constant. Increased recovery efforts could lower the net discards even more.

Table S-3

GROSS DISCARDS, RECOVERY, AND NET DISCARDS
OF MUNICIPAL SOLID WASTE
(In millions of tons)

	1960	1970	1986	2000
Gross Discards	87.5	120.5	157.7	192.7
Materials recovery	5.8	8.0	16.9	23.9
Energy recovery	-	0.4	9.6	32.0
Net discards*	81.7	112.1	131.2	136.8

* Note that these discards are lower than the discards in Table S-1 and S-2 because energy recovery has been deducted.

Source: Franklin Associates, Ltd.

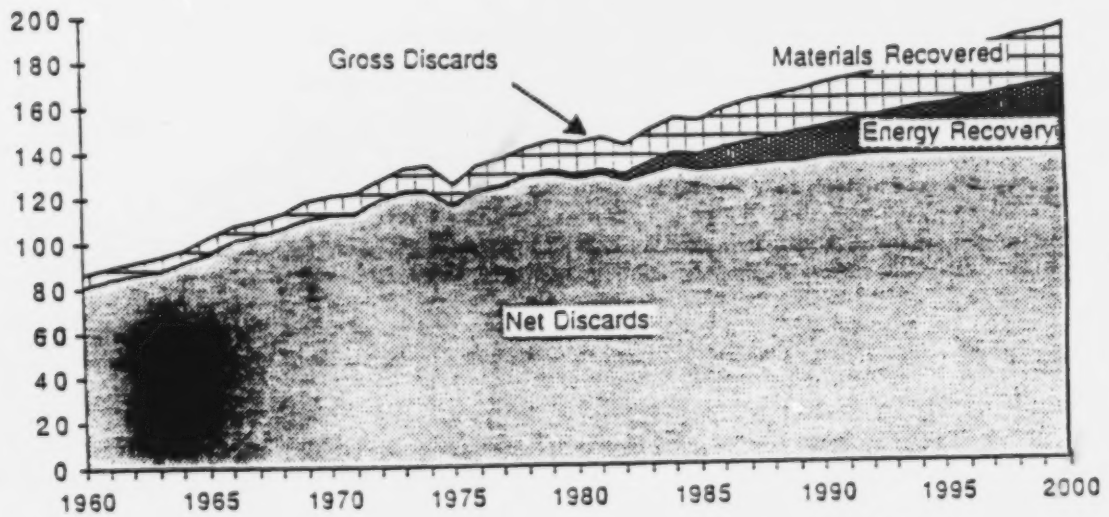

Figure S-1. Gross discards, recovery, and net discards of municipal solid waste, 1960 to 2000.

CHARACTERIZATION OF MUNICIPAL SOLID WASTE IN THE UNITED STATES, 1960 TO 2000 UPDATE 1988

BACKGROUND

In 1986 the U.S. Environmental Protection Agency (EPA) sponsored a report (1) characterizing municipal solid waste (MSW) in the United States as part of the Subtitle D Phase I study effort. This 1988 report is an update and revision of Chapter 1 of the 1986 report. Using the methodology developed previously, this report adds data points for 1985 and 1986.

There are two basic approaches to estimating quantities of municipal solid waste, which is a heterogeneous and poorly-defined aggregation of materials. The first method, which is site-specific, involves weighing, sampling, and sorting a waste stream into its specific components. Some of these efforts involve a single sampling of a waste stream; others include characterization of numerous samples over a long period of time. This method is useful, but wide variations in local conditions and the range of wastes sampled make it difficult to apply this method to obtain national average figures.

The second approach to quantifying and characterizing the municipal solid waste stream--the method used for this report--uses a material flows approach. This method is much more general in application and requires considerable manipulation of the data. In the late 1960s and early 1970s, EPA's Office of Solid Waste and its predecessors at the Public Health Service sponsored work that began to develop this methodology (2)(3)(4)(5). The material flows approach to solid waste estimation was described in some detail in a 1975 EPA publication (6), and estimates of MSW made using this methodology were published in Reports to Congress in the mid-1970s (7)(8)(9). Finally, the Resource Conservation Committee used estimates of MSW generated using this method in its 1979 Report to the President and Congress (10)(11)(12). The 1986 characterization study and this update are extensions of the earlier work.

OVERVIEW

This report provides a summary of estimates of municipal solid waste disposal for the historical period 1960 to 1986, with projections to the year 2000. Quantities and composition of MSW by materials category are presented. Changing trends in the materials and products disposed, and the amounts disposed per person, are discussed.

METHODOLOGY

General Description

Briefly described, the methodology used here relies on published data series documenting historical production (or consumption) of materials and products that enter the municipal waste stream. U.S. Department of Commerce statistics are used for many of the data series, with trade association data used in a few instances. Deductions for converting losses of materials in manufacturing processes are made.

Imports and exports significantly affect consumption of many products in the U.S. waste stream, and adjustments are made as appropriate for each product. An adjustment is also made for products that are destroyed in use (e.g., cigarette paper) or diverted from the waste stream for long periods of time (e.g., books in libraries). After all necessary adjustments are made, discards of each product are calculated.

The discards are then adjusted for materials and energy recovery. Data on recovery of the various paper grades and aluminum cans are available from trade associations. Data on recovery of rubber are available from the U.S. Department of Commerce. (These three materials account for about 90 percent of current estimated materials recovery.) Recovery of the remaining materials was estimated by Franklin Associates based on their knowledge of recycling activities in the United States. Projections of future materials recovery were made by Franklin Associates assuming no dramatic changes in current practices.

Energy recovery from municipal solid waste was estimated by compiling published data from several sources on current facilities, those under construction, and those in various stages of planning. Projections beyond the information gained from published sources were made by Franklin Associates, again assuming no dramatic changes in current trends.

Throughput in waste-to-energy facilities is normally less than design capacities. Where published data on facility throughputs were not available, Franklin Associates made estimates. When these calculations were made for EPA in the 1970s, ash from energy recovery facilities was assumed to be landfilled, and an adjustment was made for this. Incinerator ash is not, however, included in these estimates.

The final result of these calculations, or "Net Discards," represents discards that presumably would go to sanitary landfills. This procedure is illustrated in Figure 1.

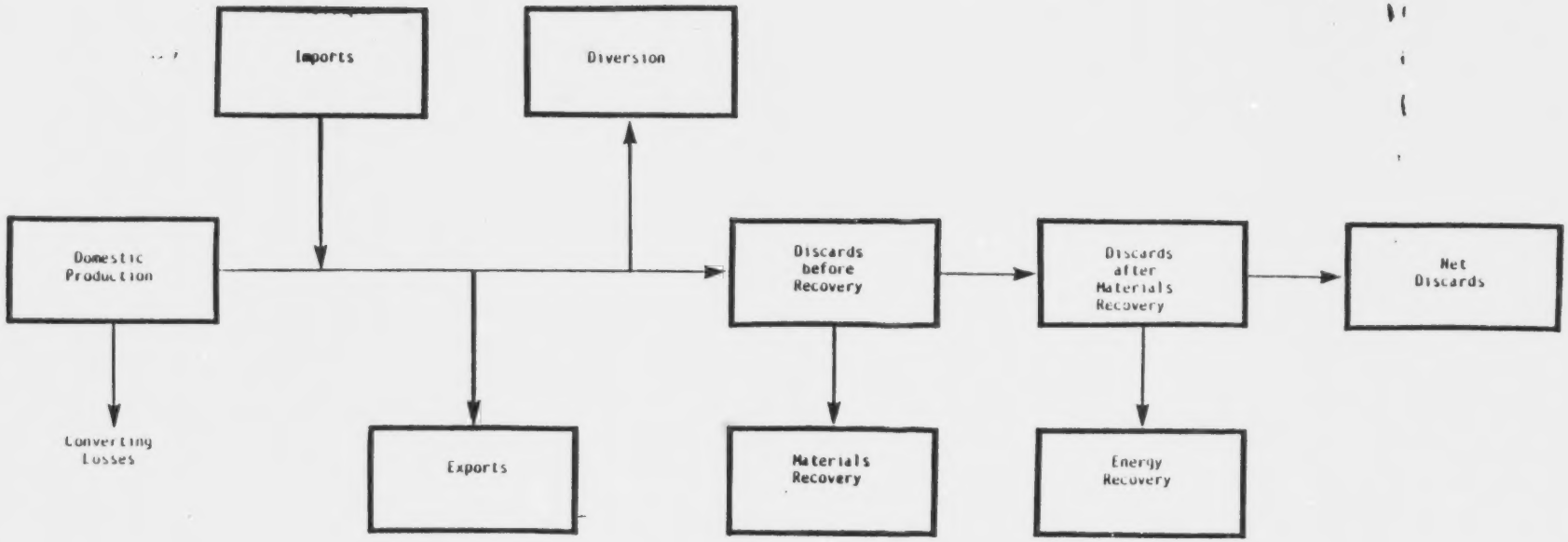

Figure 1. Generalized material flows for products in the municipal waste stream.

The methodology described above develops estimates of nonfood product wastes based on available data series. Other materials in the municipal waste stream--food wastes, yard wastes, and some miscellaneous inorganic wastes--cannot be derived from any published data series. These estimates are based on sampling data from as wide a range of sources as possible. These sources present food and yard wastes as percentages of the total waste stream, and a composite of sampling data over a period of years was used, along with the nonfood product waste data, to estimate the food, yard, and other wastes.

Materials and Products Included in These Estimates

The municipal solid waste estimates provided by the methodology described above include residential, commercial, and institutional solid wastes. Since the estimates for each product are based on production data, the methodology cannot determine whether a corrugated box, for example, was emptied and discarded in a home, a retail store, a school, or a factory; all corrugated boxes are counted. For estimates of total U.S. waste, it can be presumed that all corrugated boxes collected from any source are recycled, taken to a landfill, incinerated, or otherwise disposed. For localized estimates of MSW generation, however, it is very important to know the source of the waste stream. Using the example above, relatively few corrugated boxes come from residences, but many come from stores and factories. A waste stream generated solely from residential wastes would thus be expected to have far less than the average percentage of corrugated containers.

The broad nonfood product categories included are:

- Durable goods
- Nondurable goods
- Containers and packaging

The durable goods category includes major appliances, furniture and furnishings, and rubber tires--categories that often are referred to as "oversize and bulky" wastes. This category also includes miscellaneous durable goods such as small appliances.

The nondurable goods category includes many paper products such as newspapers, office papers, and paper towels. Apparel, footwear, and miscellaneous nondurables (especially many small plastic products) also are included in this category.

The containers and packaging category includes such items as cans, bottles, boxes, and wrapping materials made of glass, metals, paper, plastics, and wood.

To the nonfood product wastes described above are added food wastes, yard wastes, and miscellaneous inorganic wastes to complete the estimates of MSW.

The material flows methodology yields estimates of MSW discarded; it cannot determine whether the MSW was collected. Thus, soft drink cans are counted regardless of whether they are disposed in a city trash can, littered by a roadside, or disposed on-site in a remote rural area.

Materials and Products Not Included in These Estimates

Many wastes that may go to municipal landfills are not estimated by the material flows methodology. Examples of these wastes include demolition and construction wastes, sludges, automobile bodies, nonhazardous industrial wastes, incinerator residues, and nonfood products such as detergents or cosmetics that may be left inside containers.

While the material flows methodology accounts for net imports of products, it does not account for most packaging of imported goods. Thus the containers and packaging category is understated by an unknown amount.

Projections

Historical estimates of MSW discards were made through 1986. Projections to 2000 were made using a combination of trend analysis, knowledge of the industries involved, and government sources such as Industrial Outlook.

MATERIALS IN THE MUNICIPAL WASTE STREAM

Historical and projected quantities of materials in the municipal waste stream are shown in Table 1. Percentage of total discards for each material is shown in Table 2. In these tables, "Total Wastes Discarded" is discards after recovery of materials has taken place. The total discards of materials are adjusted by subtracting MSW processed for energy recovery to obtain "Net Wastes Discarded." These wastes remain to be managed by landfilling.

The relative magnitude of the various materials in the municipal waste stream is illustrated in Figure 2. Comments on each of the materials in MSW follow below.

Paper and Paperboard

The paper and paperboard category is the largest materials category, ranging from 24.5 million tons disposed in 1960 to 50 million tons disposed in 1986. Discards of paper and paperboard are projected to be 66 million tons in 2000. Paper's share of municipal waste stream discards has ranged from 30 percent to 35 percent over the past quarter-century; the trend has been generally upward and this is projected to continue. As will be shown later, paper and paperboard would comprise a much larger share of the waste stream if materials recovery did not take place.

Table 1

MATERIALS DISCARDED INTO THE MUNICIPAL WASTE STREAM, 1960 TO 2000
(In millions of tons)

Materials	1960	1965	1970	1975	1980	1981	1982	1983	1984	1985	1986	1990	1995	2000
Paper and Paperboard	24.5	32.2	36.5	34.4	42.0	43.6	41.4	45.8	49.4	48.7	50.1	54.9	60.2	66.0
Glass	6.4	8.5	12.5	13.2	14.2	14.3	13.8	13.3	12.8	12.2	11.8	12.3	12.2	12.0
Metals														
Ferrous	9.9	10.0	12.4	12.0	11.2	11.1	11.0	11.1	11.0	10.4	10.6	11.1	11.3	11.3
Aluminum	0.4	0.5	0.8	1.0	1.4	1.4	1.3	1.5	1.5	1.6	1.7	2.0	2.4	2.7
Other Nonferrous	0.2	0.2	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
Plastics	0.4	1.4	3.0	4.4	7.6	7.8	8.4	9.1	9.6	9.7	10.3	11.8	13.7	15.6
Rubber and Leather	1.7	2.2	3.0	3.7	4.1	4.1	3.8	3.4	3.3	3.4	3.9	3.5	3.6	3.8
Textiles	1.7	1.9	2.0	2.2	2.6	3.4	2.8	2.8	2.8	2.8	2.8	3.0	3.1	3.3
Wood	3.0	3.5	4.0	4.4	4.9	4.4	5.0	5.2	5.1	5.4	5.8	5.3	5.7	6.1
Other	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
TOTAL NONFOOD PRODUCT WASTES	48.2	60.5	74.7	75.6	88.6	90.5	87.8	92.6	95.9	94.5	97.4	104.2	112.5	121.3
Food Wastes	12.2	12.4	12.8	13.4	11.9	12.1	12.0	12.0	12.2	12.3	12.5	12.5	12.4	12.3
Yard Wastes	20.0	21.6	23.2	25.2	26.5	26.7	27.0	27.5	27.8	28.0	28.3	29.5	31.0	32.0
Miscellaneous Inorganic Wastes	1.3	1.6	1.8	2.0	2.2	2.3	2.4	2.4	2.4	2.5	2.6	2.8	3.0	3.2
TOTAL WASTES DISCARDED*	81.7	96.1	112.5	116.2	129.2	131.6	129.1	134.5	138.3	137.3	140.8	149.0	158.9	168.8
ENERGY RECOVERY**	0.0	0.2	0.4	0.7	2.7	2.3	3.5	5.0	6.5	7.6	9.6	13.3	22.5	32.0
NET WASTES DISCARDED	81.7	95.9	112.1	115.5	126.5	129.3	125.6	129.5	131.8	129.7	131.2	135.7	136.4	136.8

* Wastes discarded after materials recovery has taken place.
** Municipal solid waste consumed for energy recovery. Does not include residues.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

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Table 2

MATERIALS DISCARDED INTO THE MUNICIPAL WASTE STREAM, 1960 TO 2000
(In percent of total discards)

Materials	1960	1965	1970	1975	1980	1981	1982	1983	1984	1985	1986	1990	1995	2000
Paper and Paperboard	30.0	33.5	32.4	29.6	32.5	33.1	32.1	34.1	35.7	35.5	35.6	36.8	37.9	39.1
Glass	7.8	8.8	11.1	11.4	11.0	10.9	10.7	9.9	9.3	8.9	8.4	8.3	7.7	7.1
Metals														
Ferrous	12.1	10.4	11.0	10.3	8.7	8.4	8.5	8.3	8.0	7.6	7.5	7.4	7.1	6.7
Aluminum	0.5	0.5	0.7	0.9	1.1	1.1	1.0	1.1	1.1	1.2	1.2	1.3	1.5	1.6
Other Nonferrous	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Plastics	0.5	1.5	2.7	3.8	5.9	5.9	6.5	6.8	6.9	7.1	7.3	7.9	8.6	9.2
Rubber and Leather	2.1	2.3	2.7	3.2	3.2	3.1	2.9	2.5	2.4	2.5	2.8	2.3	2.3	2.3
Textiles	2.1	2.0	1.8	1.9	2.0	2.6	2.2	2.1	2.0	2.0	2.0	2.0	2.0	2.0
Wood	3.7	3.6	3.6	3.8	3.8	3.3	3.9	3.9	3.7	3.9	4.1	3.6	3.6	3.6
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0.0
TOTAL NONFOOD PRODUCTS	59.0	62.9	66.4	65.1	68.6	68.8	68.0	68.8	69.3	68.8	69.2	69.9	70.8	71.8
Food Wastes	14.9	12.9	11.4	11.5	9.2	9.2	9.3	8.9	8.8	9.0	8.9	8.4	7.8	7.3
Yard Wastes	24.5	22.5	20.6	21.7	20.5	20.3	20.9	20.4	20.1	20.4	20.1	19.8	19.5	19.0
Miscellaneous Inorganic Wastes	1.6	1.7	1.6	1.7	1.7	1.7	1.8	1.8	1.7	1.8	1.8	1.9	1.9	1.9
TOTAL WASTES DISCARDED*	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
ENERGY RECOVERY**	0.0	0.2	0.4	0.6	2.1	1.7	2.7	3.7	4.7	5.5	6.8	8.9	14.2	19.0
NET WASTES DISCARDED	100.0	99.8	99.6	99.4	97.9	98.3	97.3	96.3	95.3	94.5	93.2	91.1	85.8	81.0

* Wastes discarded after materials recovery has taken place.
** Municipal solid waste consumed for energy recovery. Does not include residues.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

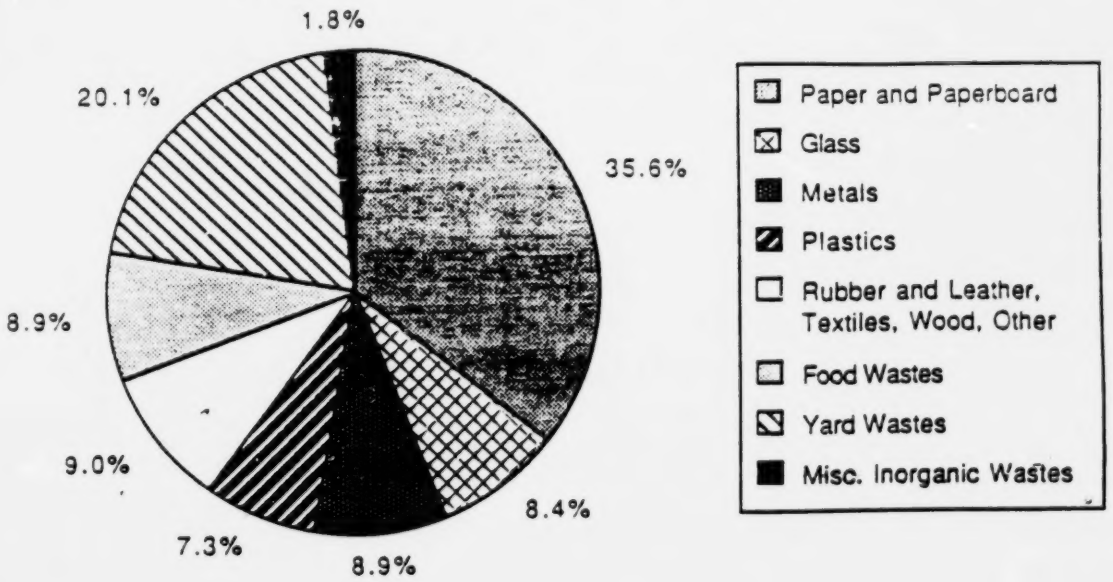

Figure 2. Materials discarded into the municipal waste stream in 1986, in percent of total.

Glass

The tonnage of glass (mostly containers) in the waste stream increased steadily until the early 1980s, then began to fall slowly. As a percentage of the waste stream, glass comprised 8 percent in 1960, rising to over 11 percent in the early 1980s, then falling to 8 percent in 1986. The percentage of glass in the waste stream is projected to fall to under 8 percent by 2000.

Ferrous Metals

Ferrous metals total about 10 to 11 million tons in the waste stream at present. The ferrous metals tonnage has remained fairly constant over the years; thus as a percent of the total, ferrous metals have decreased, from 12 percent in 1960 to 7.5 percent in 1986. This trend is projected to continue.

Aluminum

Aluminum in the municipal waste stream has increased steadily, but the tonnage of this light metal is still very small--only 1.7 million tons in 1986. In percentage, aluminum has grown from less than one-half of one percent in 1960 to just over one percent in 1986. The increasing trend is expected to continue.

Other Nonferrous Metals

These metals (e.g., copper, brass) comprise a very small share of the municipal waste stream--less than one percent. Their tonnage has been about 300,000 tons in recent years, and this is projected to increase to 400,000 tons in 2000.

Plastics

Plastics in the waste stream have increased steadily, from about one-half million tons in 1960 to over 10 million tons in 1986. This trend will continue, to 15.6 million tons in 2000. Plastics were less than one percent of the waste stream in 1960, were over 7 percent in 1986, and are projected to rise to over 9 percent in 2000.

Rubber and Leather

This category, which includes rubber tires, grew in tonnage from 1.7 million tons in 1960 to 4.1 million tons in 1981. Tonnage since then has been in a decline, and any growth is expected to be very slow. Rubber and leather have ranged from 2.1 percent to 3.2 percent of the waste stream, and the percentage is projected to remain under 3 percent.

Textiles

Textiles have stayed at a fairly constant 2 percent of the municipal waste stream. Tonnage has ranged between 2 million and 3.4 million tons, and this is not projected to change.

Wood

Wood in the municipal waste stream is estimated at 3 million tons in 1960, increasing to 5 million tons in the early 1980s, and con-

tinuing to grow slowly, to 6 million tons in 2000. The percentage of wood has been about 4 percent of the total, or slightly less.

Food Wastes

Disposal of food wastes in the U.S. is poorly documented compared to other product wastes. Based on previous EPA work, the increasing use of garbage disposers in homes, and MSW sampling studies that show food wastes declining as a percent of total, food wastes are estimated to have increased from 12.2 million tons in 1960 to 13.4 million tons in 1975. Food wastes are estimated to show a slightly decreasing tonnage thereafter, to 12.3 million tons in 2000.

In terms of percentage of net discards in the waste stream, food wastes are estimated to have fallen from nearly 15 percent in 1960, to about 9 percent in 1986, decreasing to about 7 percent in 2000.

Yard Wastes

Like food wastes, yard wastes are poorly documented, and they vary widely from region to region. Based on previous work and sampling studies, yard wastes were estimated to be 20 million tons in 1960, increasing to 28.3 million tons in 1986, and increasing to 32 million tons in 2000. Percentage of total has decreased from about 24 percent in 1960 to about 20 percent in 1986.

Miscellaneous Inorganic Wastes

This category, mostly stones and dirt, is also poorly documented. Estimates were kept similar to those that have been made before (6)(7)(8)(9). The tonnage increases slowly from 1.3 million tons in 1960 to 2.6 million tons in 1986, with a slow increase thereafter, to 3.2 million tons. This category represents less than 2 percent of the municipal waste stream.

PRODUCTS IN THE MUNICIPAL WASTE STREAM

With the exception of food, yard, and miscellaneous inorganic wastes, the materials in the waste stream are present in manufactured products. These product categories are shown in Tables 3 and 4 and Figure 3. The product wastes are categorized as durable goods, nondurable goods, and containers and packaging. The products are discussed below.

Durable Goods

Total durables discarded have increased from 9 million tons in 1960 to 19.2 million tons in 1986. They are projected to reach 23 million

Table 3

PRODUCTS DISCARDED INTO THE MUNICIPAL WASTE STREAM, 1960 TO 2000

(In millions of tons)

Products	1960	1965	1970	1975	1980	1981	1982	1983	1984	1985	1986	1990	1995	2000
Durable Goods														
Major Appliances	1.5	1.0	2.6	2.5	2.7	2.8	2.8	2.8	2.6	2.5	2.6	2.6	2.8	2.8
Furniture and Furnishings	2.2	2.7	3.4	4.1	5.1	5.3	6.0	6.3	6.0	5.8	6.4	6.4	7.2	8.3
Rubber Tires	0.8	1.0	1.6	2.3	2.3	2.3	2.3	1.5	1.3	1.4	1.7	1.6	1.7	1.7
Miscellaneous Durables	4.6	5.4	6.3	7.0	7.7	7.8	8.2	8.4	8.7	8.3	8.5	9.6	10.0	10.5
TOTAL DURABLES	9.1	10.1	13.9	15.9	17.8	18.2	18.9	19.0	18.6	18.0	19.1	20.2	21.7	23.0
Nondurable Goods														
Newspapers	5.3	6.3	7.2	6.4	8.1	8.4	7.6	6.2	8.9	9.0	8.8	9.3	10.2	11.1
Books and Magazines	2.8	3.4	3.0	3.0	3.1	3.2	3.3	3.8	4.4	4.4	4.6	5.0	5.6	6.9
Office Papers	1.3	1.8	2.0	2.0	3.1	3.1	3.1	3.6	4.3	4.8	5.3	5.9	6.6	7.5
Commercial Printing	0.6	1.0	1.8	1.8	2.7	2.7	2.8	3.1	3.4	3.8	4.2	4.6	4.3	4.6
Tissue Paper and Towels	1.1	1.5	2.1	2.1	2.4	2.4	2.6	2.6	2.8	2.8	2.9	3.2	3.5	3.6
Other Nonpackaging Paper	2.8	4.1	3.8	3.6	4.3	4.6	4.3	5.0	4.7	5.1	5.3	5.8	6.4	6.9
Clothing and Footwear	1.3	1.5	1.6	1.7	2.3	2.6	2.4	2.5	1.8	2.7	3.0	2.6	2.8	3.2
Other Miscellaneous Nondurables	0.4	0.5	0.7	1.0	2.4	2.4	2.3	2.5	2.7	2.6	2.8	3.1	3.6	4.2
TOTAL NONDURABLES	15.1	19.2	22.4	20.8	28.6	29.4	28.2	31.3	33.0	34.2	35.4	38.5	42.7	47.5
Containers and Packaging														
Glass														
Beer and Soft Drink Bottles	1.3	2.5	5.4	5.9	6.0	6.0	5.8	5.4	4.8	4.7	4.5	4.4	4.3	4.1
Wine and Liquor Bottles	0.9	1.4	1.9	2.3	2.4	2.4	2.2	2.2	2.2	2.2	2.1	2.2	2.2	2.1
Food and Other Bottles & Jars	3.4	4.2	4.4	4.6	4.8	4.8	4.8	4.7	4.7	4.3	4.1	4.6	4.5	4.5
Total Glass	5.9	8.3	11.7	12.3	13.2	13.3	12.8	12.3	11.7	11.1	10.7	11.2	11.0	10.8
Steel														
Beer and Soft Drink Cans	0.6	0.9	1.6	1.2	0.5	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Food and Other Cans	3.7	3.6	3.5	3.3	2.7	2.6	2.5	2.5	2.3	2.5	2.4	2.3	2.0	1.8
Other Steel Packaging	0.2	0.2	0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Steel	4.6	4.7	5.3	4.7	3.4	3.2	2.9	2.8	2.8	2.8	2.7	2.6	2.4	2.1
Aluminum														
Beer and Soft Drink Cans	0.1	0.1	0.3	0.4	0.6	0.5	0.5	0.5	0.6	0.6	0.7	0.7	0.8	1.0
Other Cans	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Foil and Closures	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5
Total Aluminum	0.2	0.3	0.6	0.6	0.9	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.4	1.5
Paper and Paperboard														
Corrugated Boxes	4.7	7.6	9.7	9.5	10.0	11.2	9.9	10.8	11.8	10.9	11.4	12.5	14.1	15.8
Other Paperboard	3.5	4.1	4.3	3.9	4.3	4.2	4.3	4.6	4.9	5.0	5.1	4.9	5.0	5.0
Paper Packing	2.7	3.1	3.4	2.9	3.7	3.6	3.7	3.9	4.1	3.9	3.9	4.6	4.7	4.9
Total Paper	11.0	14.9	17.4	16.3	18.1	19.1	17.9	19.3	20.8	19.9	20.4	22.0	23.8	25.8
Plastics														
Plastic Containers	0.1	0.3	0.9	1.3	2.1	2.1	2.0	2.2	2.4	2.6	2.8	2.9	3.4	3.9
Other Packaging	0.1	0.7	1.2	1.4	2.1	2.2	2.2	2.4	2.6	2.7	2.8	3.2	3.8	4.3
Total Plastics	0.2	1.0	2.1	2.8	4.2	4.3	4.2	4.6	5.0	5.3	5.6	6.2	7.2	8.2
Wood Packaging	2.0	2.0	2.1	2.0	2.1	2.1	2.0	2.0	2.0	2.1	2.1	2.0	2.0	2.0
Other Miscellaneous Packaging	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
TOTAL CONTAINERS AND PACKAGING	24.0	31.0	39.3	38.9	42.1	43.0	40.8	42.1	43.5	42.3	42.7	45.4	48.1	50.7
TOTAL NONFOOD PRODUCT WASTES	48.2	60.5	74.7	75.6	88.6	90.5	87.8	92.6	95.9	94.5	97.4	104.2	112.5	121.3
Other Wastes														
Food Wastes	12.2	13.4	15.8	13.4	11.9	12.1	12.0	12.3	12.2	12.3	12.5	12.5	12.4	12.3
Yard Wastes	20.0	21.6	23.2	25.2	26.5	26.7	27.0	27.5	27.8	28.0	28.3	29.5	31.0	32.0
Miscellaneous Inorganic Wastes	1.3	1.6	1.8	2.0	2.2	2.3	2.4	2.4	2.4	2.5	2.6	2.8	3.0	3.2
TOTAL OTHER WASTES	33.5	36.6	37.8	40.6	40.8	41.2	41.4	41.9	42.4	42.8	43.4	44.8	46.4	47.5
TOTAL WASTES DISCARDED*	81.7	96.1	112.5	116.2	129.2	131.6	129.1	134.5	138.3	137.3	140.8	149.0	158.9	168.8
ENERGY RECOVERY**	-	0.2	0.4	0.7	0.7	0.8	3.5	3.5	6.5	7.6	9.6	13.3	22.5	32.0
NET WASTES DISCARDED	81.7	95.9	112.1	115.5	128.5	129.3	125.6	129.5	131.8	129.7	131.2	135.7	136.4	136.8

* Wastes discarded after materials recovery has taken place.

** Municipal solid waste consumed for energy recovery. Does not include residues.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Table 4

PRODUCTS DISCARDED INTO THE MUNICIPAL WASTE STREAM, 1960 TO 2000
(In percent of total discards)

Products	1960	1965	1970	1975	1980	1981	1982	1983	1984	1985	1986	1990	1995	2000
Durable Goods														
Major Appliances	1.8	1.0	2.3	2.2	2.1	2.1	2.2	2.1	1.9	1.8	1.8	1.7	1.8	1.7
Furniture and Furnishings	2.7	2.8	3.0	3.5	3.9	4.0	4.6	4.7	4.1	4.2	4.3	4.3	4.5	4.7
Rubber Tires	1.0	1.0	1.4	2.0	1.8	1.7	1.5	1.1	0.9	1.0	1.2	1.2	1.1	1.0
Miscellaneous Durables	5.6	5.6	5.6	6.0	6.0	5.9	6.4	6.2	6.3	6.0	6.0	5.4	6.3	6.2
TOTAL DURABLES	11.1	10.5	12.4	13.7	13.8	13.8	14.7	14.1	13.4	13.1	13.6	13.6	13.7	13.6
Nondurable Goods														
Newspapers	6.5	6.6	6.4	5.5	6.3	6.4	5.9	6.1	6.4	6.6	6.3	6.2	6.4	6.6
Books and Magazines	2.2	2.1	2.0	1.9	2.4	2.4	2.6	2.8	3.2	3.2	3.1	3.4	3.5	3.9
Office Papers	1.6	1.9	1.8	1.7	2.4	2.4	2.4	2.7	3.1	3.5	3.6	4.0	4.2	4.4
Commercial Printing	1.3	1.7	1.6	1.5	2.1	2.1	2.2	2.3	2.5	2.0	2.3	2.4	2.5	2.7
Tissue Paper and Towels	1.3	1.6	1.9	1.8	1.9	1.8	1.9	1.9	2.0	2.0	2.1	2.1	2.2	2.3
Other Nonpackaging Paper	3.4	4.3	3.4	3.1	3.5	3.5	3.3	3.7	3.4	3.7	3.8	3.9	4.0	4.1
Clothing and Footwear	1.6	1.6	1.4	1.5	1.8	2.0	1.9	1.9	1.3	2.0	2.1	1.7	1.8	1.9
Other Miscellaneous Nondurables	0.5	0.5	0.6	0.9	1.9	1.8	1.8	1.9	2.0	1.9	2.0	2.1	2.3	2.5
TOTAL NONDURABLES	18.5	20.2	19.0	17.7	22.1	22.3	22.8	23.3	23.9	24.9	25.1	25.8	26.9	28.1
Containers and Packaging														
Glass														
Beer and Soft Drink Bottles	1.6	2.6	4.8	5.1	4.6	4.6	4.5	4.0	3.5	3.4	3.2	3.0	2.7	2.4
Wine and Liquor Bottles	1.1	1.5	1.7	1.7	1.9	1.8	1.7	1.6	1.6	1.6	1.5	1.5	1.4	1.2
Food and Other Bottles & Jars	4.2	4.4	3.9	3.8	3.7	3.6	3.7	3.5	3.4	3.1	2.9	3.1	2.8	2.7
Total Glass	7.2	8.3	10.4	10.6	10.2	10.1	9.9	9.1	8.5	8.1	7.6	7.5	6.9	6.4
Steel														
Beer and Soft Drink Cans	0.7	0.9	1.4	1.0	0.6	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Food and Other Cans	4.5	3.7	3.1	2.8	2.1	2.0	1.9	1.9	1.8	1.8	1.7	1.5	1.3	1.1
Other Steel Packaging	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total Steel	5.6	4.9	4.7	4.0	2.6	2.4	2.2	2.1	2.0	2.0	1.9	1.7	1.5	1.2
Aluminum														
Beer and Soft Drink Cans	0.1	0.1	0.3	0.3	0.5	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.6
Other Cans	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Foil and Closures	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
Total Aluminum	0.2	0.3	0.5	0.5	0.7	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.9	0.9
Paper and Paperboard														
Corrugated Boxes	5.8	7.9	8.6	8.2	7.7	8.5	7.7	8.0	8.5	7.9	8.1	8.4	8.9	9.4
Other Paperboard	4.3	4.3	3.8	3.4	3.3	3.2	3.3	3.4	3.5	3.6	3.6	3.3	3.1	3.0
Paper Packaging	3.3	3.2	3.0	2.5	2.9	2.7	2.9	2.9	3.0	2.8	2.8	3.1	3.0	2.9
Total Paper	13.5	15.5	15.5	14.0	14.0	14.5	13.9	14.3	15.0	14.5	14.5	14.8	15.0	15.3
Plastics														
Plastic Containers	0.1	0.3	0.8	1.1	1.6	1.6	1.5	1.6	1.7	1.9	2.0	1.9	2.1	2.3
Other Packaging	0.1	0.7	1.1	1.2	1.6	1.7	1.7	1.8	1.9	2.0	2.0	2.1	2.4	2.5
Total Plastics	0.1	1.0	1.9	2.4	3.3	3.3	3.3	3.4	3.6	3.9	4.0	4.2	4.5	4.9
Wood Packaging	2.4	2.1	1.9	1.7	1.6	1.6	1.5	1.5	1.4	1.5	1.5	1.3	1.3	1.2
Other Miscellaneous Packaging	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2
TOTAL CONTAINERS AND PACKAGING	29.4	32.3	34.9	33.5	32.6	32.7	31.6	31.3	31.5	30.8	30.3	30.5	30.3	30.0
TOTAL NONFOOD PRODUCT WASTES	59.0	62.9	66.4	65.1	68.6	68.8	68.0	68.8	69.3	68.8	69.2	69.9	70.8	71.8
Other Wastes														
Food Wastes	14.9	12.9	11.4	11.5	9.2	9.2	9.3	8.9	8.8	9.0	8.9	8.4	7.8	7.3
Yard Wastes	24.5	23.5	20.6	21.7	20.5	20.3	20.9	20.4	20.1	20.4	20.1	19.8	19.5	19.0
Miscellaneous Inorganic Wastes	1.6	1.7	1.6	1.7	1.7	1.7	1.8	1.8	1.7	1.8	1.8	1.9	1.9	1.9
TOTAL OTHER WASTES	41.0	37.0	33.6	34.9	31.4	31.2	32.1	31.2	30.7	31.2	30.8	30.1	29.2	28.1
TOTAL WASTES DISCARDED*	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
ENERGY RECOVERY**	-	0.2	0.4	0.6	2.1	2.7	3.7	4.7	5.5	6.8	8.9	14.2	19.0	
NET WASTES DISCARDED	100.0	99.8	99.6	99.4	97.9	97.3	96.3	95.3	94.5	93.2	91.1	85.8	81.0	

* Wastes discarded after materials recovery has taken place.
** Municipal solid waste consumed for energy recovery. Does not include residues.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

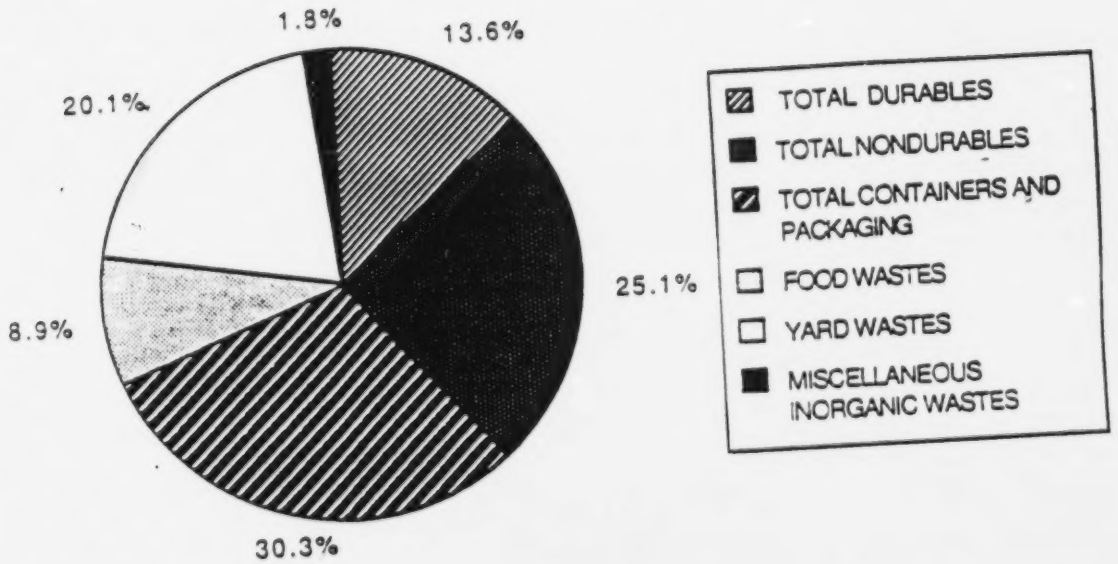

Figure 3. Products discarded into the municipal waste stream, 1986, in percent of total.

tons in 2000. As a percentage of the municipal waste stream, durable goods have increased only slightly, from 11 percent in 1960 to 13.6 percent in 1986; this is projected to be about 14 percent in 2000.

Discards of major appliances increased from 1.5 million tons in 1960 to 2.6 million tons in 1970. Discards have been nearly constant since then, and are expected to remain so. Appliances have been about 2 percent of total discards for the entire period.

Discards of furniture and furnishings increased from 2.2 million tons in 1960 to 6.4 million tons in 1986. They will continue to increase slowly to 2000. Furniture and furnishings as a percentage of total discards have increased slowly from about 3 percent in 1960 to 4.5 percent in 1986. They are projected to comprise 4.7 percent of total discards in 2000.

Rubber tires are an exception to the usual increase in product tonnage discarded. Tire discards were 800,000 tons in 1960, increased to 2.3 million tons, then began to decline in 1982. There are two main reasons for the decline in discards of rubber tires--tires are smaller than they were in former years, and they last longer. Tires have been one to 2 percent of the waste stream historically, and this percentage is expected to be about one percent in 2000.

The products classified as miscellaneous durables are varied, and not well documented. Small appliances and consumer electronics are important constituents of the category. Estimated discards have increased from 4.6 million tons in 1960 to 8.5 million tons in 1986. Discards in 2000 are projected to be 10.5 million tons. These goods comprise 6 percent of the waste stream.

Nondurable Goods

The nondurable goods category has grown from 15 million tons in 1960 to 35.4 million tons in 1986. Nondurables are projected to contribute 47.5 million tons to the waste stream in 2000. In terms of percentage of the waste stream, nondurables were 18.5 percent in 1960, increased to about 25 percent in 1986, and are projected to be about 28 percent in 2000.

Paper products comprise the majority of nondurable goods. The total paper nondurables were 16.3 percent of the waste stream in 1960, increasing to over 21 percent in 1986. Newspapers are the largest single nondurable category; they have been over 6 percent of total waste discards for the entire period. The categories of books, magazines, office papers, and commercial printing have been increasing in percentage of total during the 1980s, and are expected to continue to do so. Tissue and other papers have maintained a more constant percentage in the waste stream.

Clothing and footwear consistently comprise about 2 percent of the waste stream. These goods increased from 1.3 million tons in 1960 to 3 million tons in 1986, with discards in 2000 projected at 3.2 million tons.

Miscellaneous nondurables in the waste stream are not well documented. They are estimated to have increased from 400,000 tons in 1960 to 2.8 million tons in 1986, with increases to 4.2 million tons in 2000. In percentage, this category has increased from less than one percent in 1960 to 2 percent in 1986, with a projected increase to 2.5 percent in 2000.

Containers and Packaging

Containers and packaging are a very important part of the municipal waste stream, increasing from 24 million tons in 1960 to 42.7 million tons in 1986. They are projected to contribute over 50 million tons to total wastes in 2000. Containers and packaging were 29.4 percent of total discards in 1960, 33.5 percent in 1970, and 30.3 percent in 1986. They are projected to be 30 percent of total discards in 2000. The decreasing percentage is apparently due to increasing replacement of relatively heavy materials--glass and ferrous metals--with lighter materials such as aluminum and plastics.*

Each material component of the containers and packaging category is discussed briefly below.

Glass. Beer and soft drink bottles, wine and liquor bottles, and food bottles and jars are the important glass container categories. Total glass containers increased from 5.9 million tons in 1960 to 13.3 million tons in 1981, then decreased to 10.7 million tons in 1986. In terms of percentage, glass containers were over 7 percent of total discards in 1960, increased to almost 11 percent, then dropped to 7.6 percent in 1986.

Tonnage of glass containers in the waste stream is projected to be rather flat, at under 11 million tons in 2000. This would be 6.4 percent of total discards.

Steel. Steel containers include beer and soft drink cans, food cans, and some other miscellaneous packaging. Tonnage was 4.6 million tons in 1960, increased to 5.3 million tons in 1970, and has dropped ever since. Steel containers were 5.6 percent of total discards in 1960,

* As products decrease in weight, there may not be a corresponding decrease in volume. An aluminum soft drink can and one made of steel are the same size, to cite one example. Relationships between volume and weight of the components of MSW have not been well established, so far as is known.

decreasing to about 2 percent in 1986. They are projected to be just over one percent of total discards in 2000.

Aluminum. Aluminum beer and soft drink cans comprise the majority of this category of containers. Aluminum container discards have increased rapidly, from 200,000 tons in 1960 to one million tons in 1986. Tonnage in 2000 is projected at 1.5 million tons. In spite of the rapid increase, aluminum represents less than one percent of total discards because of its light weight.

Paper and Paperboard. This category includes corrugated containers, boxboard containers (e.g., cereal boxes), and paper packaging such as grocery sacks. This is an important waste category, increasing from 11 million tons in 1960 to 20.4 million tons in 1986, with a projected 25.8 million tons in 2000. Paper and paperboard containers and packaging were 13.5 percent of total discards in 1960, increasing to 14.5 percent in 1986 and 15.3 percent in 2000.

Corrugated containers are the largest single component of this category, increasing from 4.7 million tons in 1960 to 11.4 million tons in 1986. They are projected to reach 15.8 million tons in 2000. Corrugated boxes were 8 percent of total discards in 1986.

Plastics. Plastic containers and packaging have grown dramatically, from a negligible percentage of total discards in 1960 to 4 percent in 1986. Tonnage was 100,000 tons in 1960 and 5.6 million tons in 1986; it is projected at 8.2 million tons in 2000.

Wood. Wood packaging includes shipping pallets and boxes. Although not well documented, this category is thought to have remained about constant at 2 million tons. As a percent of total, wood packaging has decreased from 2.4 percent in 1960 to 1.5 percent in 1986, and is projected to be 1.2 percent in 2000.

Other Miscellaneous Packaging. This category includes small amounts of textiles, leather, etc., used in specialty packaging. The category represents a negligible percentage of total discards.

TRENDS IN MUNICIPAL SOLID WASTE

This 40-year data series affords the opportunity to examine long-term trends in municipal solid waste management in the United States. Tables 1 through 4 of this report provide data on net discards of MSW--the quantities that must be landfilled. In this section data on gross discards, materials recovery, and energy recovery are provided. Trends in per capita discards and organic versus inorganic portions of the waste stream are also discussed.

The Effects of Materials and Energy Recovery on Wastes Discarded

Historical and projected gross discards of MSW, materials recovery, energy recovery, and net discards are shown in Tables 5 and 6. Gross discards of MSW have grown from 87.5 million tons in 1960 to 157.7 million tons in 1986. Growth to 192.7 million tons in 2000 is projected. Gross discards on a per capita basis grew from 2.65 pounds per person per day in 1960 to 3.58 pounds per person per day in 1986; in 2000, 3.94 pounds per person per day are projected.

At the same time, materials recovered for recycling have increased from 5.8 million tons in 1960 to 16.9 million tons in 1986. Subtraction of this tonnage drops the per capita discards to 3.19 pounds per person per day in 1986, with 3.45 pounds per person per day projected in 2000.

Incineration of MSW for energy recovery began in the late 1960s, with significant amounts of MSW beginning to be consumed in the 1980s. Subtraction of this tonnage lowers the net discards to 131.2 million tons in 1986, with projected discards of 136.8 million tons in 2000. On a per-capita basis, the combined effect of materials and energy recovery causes the pounds per person per day to "flatten out" in the 1980s and decline in the 1990s.

These observations are illustrated in Figure 4. Gross discards (the top line) show a steady overall increase. (It is worth noting that economic recessions, such as those in 1975 and 1982, cause a decline in the waste generated. There was also a mild decline in 1985.) Materials recovery and energy recovery cause the net discards (to be landfilled) to stay more or less flat after 1986. The estimates of materials and energy recovery used here are fairly conservative, representing a continuation of current trends. There is, therefore, the possibility that net discards to be landfilled can be reduced further if the levels of recycling and energy recovery are increased.

Discards and Materials Recovery in 1986

A more detailed picture of gross discards, materials recovery, and net discards is shown in Table 7 (materials) and Table 8 (products). Table 7 shows that the tonnage of recovered materials in 1986 was mostly paper and paperboard, with recovery at 22.6 percent of gross discards. If there were no materials recovery, paper and paperboard would be 41 percent of MSW discarded instead of 35.6 percent after recovery. Aluminum has a higher percentage recovery (25 percent), but its tonnage is comparatively very small.

Table 5

GROSS DISCARDS, RECOVERY, AND NET DISCARDS OF MUNICIPAL SOLID WASTE, 1960 TO 2000
(In millions of tons)

Year	Gross Discards	Materials Recovery	Discards After Materials Recovery	Energy Recovery	Net Discards
1960	87.5	5.8	81.7	-	81.7
1965	102.3	6.2	96.1	0.2	95.9
1970	120.5	8.0	112.5	0.4	112.1
1975	125.3	9.1	116.2	0.7	115.5
1980	142.6	13.4	129.2	2.7	126.5
1981	144.8	13.2	131.6	2.3	129.3
1982	142.0	12.9	129.1	3.5	125.6
1983	148.4	13.9	134.5	5.0	129.5
1984	153.6	15.3	138.3	6.5	131.8
1985	152.5	15.3	137.3	7.6	129.7
1986	157.7	16.9	140.8	9.6	131.2
1990	167.4	18.4	149.0	13.3	135.7
1995	180.1	21.2	158.9	22.5	136.4
2000	192.7	23.9	168.8	32.0	136.8

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Table 6

GROSS DISCARDS, RECOVERY, AND NET DISCARDS OF MUNICIPAL SOLID WASTE, 1960 TO 2000
(In pounds per person per day)

Year	Gross Discards	Materials Recovery	Discards After Materials Recovery	Energy Recovery	Net Discards
1960	2.65	0.18	2.48	-	2.48
1965	2.88	0.17	2.71	0.01	2.70
1970	3.22	0.21	3.01	0.01	3.00
1975	3.18	0.23	2.95	0.02	2.93
1980	3.43	0.32	3.11	0.06	3.04
1981	3.45	0.31	3.13	0.05	3.08
1982	3.35	0.30	3.04	0.08	2.96
1983	3.47	0.32	3.14	0.12	3.03
1984	3.56	0.35	3.20	0.15	3.05
1985	3.49	0.35	3.14	0.17	2.97
1986	3.58	0.39	3.19	0.22	2.98
1990	3.67	0.40	3.27	0.29	2.98
1995	3.80	0.45	3.35	0.47	2.88
2000	3.94	0.49	3.45	0.65	2.80

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

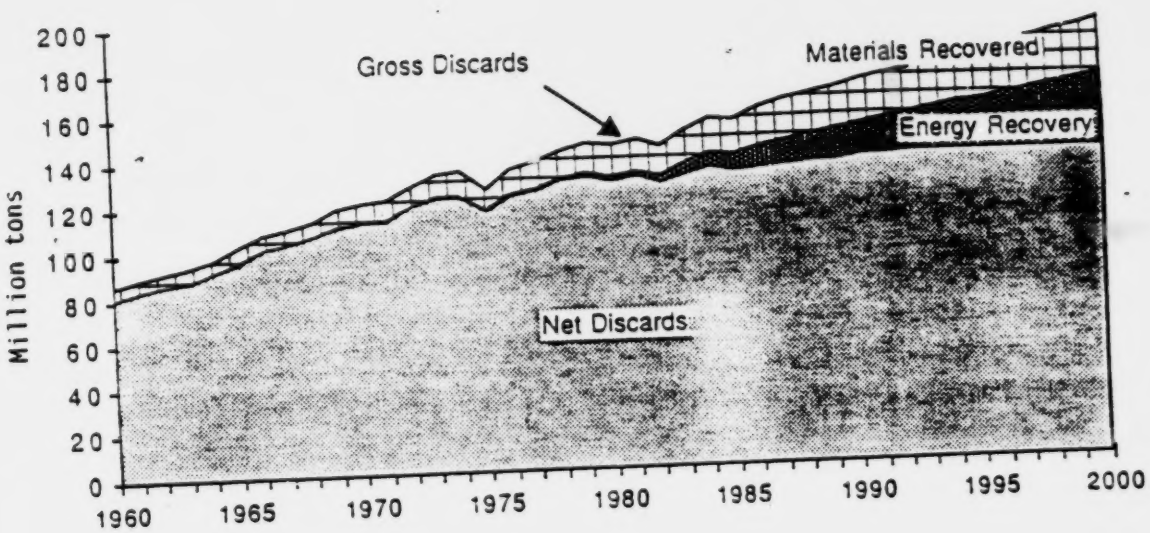

Figure 4. Gross discards, recovery, and net discards of municipal solid waste, 1960 to 2000.

Table 7

GROSS DISCARDS, RECOVERY, AND NET DISCARDS OF MATERIALS IN MUNICIPAL SOLID WASTE, 1986
(In millions of tons and percent)

Materials	Gross Discards		Materials Recovery		Net Discards**	
	Quantity	% of Gross Discards	Quantity	% of Gross Discards	Quantity	% of Net Discards
Paper and Paperboard	64.7	41.0	14.6	22.6	50.1	35.6
Glass	12.9	8.2	1.1	8.5	11.8	8.4
Ferrous Metals	11.0	7.0	0.4	3.6	10.6	7.5
Aluminum	2.4	1.5	0.6	25.0	1.7	1.2
Other Nonferrous Metals	0.3	0.2	Neg.	0.0	0.3	0.2
Plastics	10.3	6.5	0.1	1.0	10.3	7.3
Rubber and Leather	4.0	2.5	0.1	2.5	3.9	2.8
Textiles	2.8	1.8	Neg.	0.0	2.8	2.0
Wood	5.8	3.7	Neg.	0.0	5.8	4.1
Other	0.1	0.1	-	0.0	0.1	0.1
TOTAL NONFOOD PRODUCT WASTES	114.3	72.5	17.0	14.9	97.4	69.2
Food Wastes*	12.5	7.9	Neg.	0.0	12.5	8.9
Yard Wastes*	28.3	17.9	Neg.	0.0	28.3	20.1
Miscellaneous Inorganic Wastes	2.6	1.6	Neg.	0.0	2.6	1.8
TOTAL WASTES	157.7	100.0	17.0	10.8	140.8	100.0

* Some of these wastes are composted or otherwise recovered, but this recovery is not estimated here.
** Discards after materials recovery and before energy recovery.

Neg. = Less than 100,000 tons.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Table 8

GROSS DISCARDS, RECOVERY, AND NET DISCARDS OF PRODUCTS IN MUNICIPAL SOLID WASTE, 1986
(In millions of tons and percent)

Products	Gross Discards		Materials Recovery		Net Discards**	
	Quantity	% of Gross Discards	Quantity	% of Gross Discards	Quantity	% of Net Discards
DURABLE GOODS	2.8	1.8	0.2	7.1	2.6	1.8
Major Appliances	1.8	1.1	0.1	5.6	1.7	1.2
Rubber Tires	14.9	9.4	0.1	0.7	14.9	10.6
Other Durables						
TOTAL DURABLES	19.5	12.4	0.4	2.1	19.1	13.6
NONDURABLE GOODS	12.6	8.0	3.8	30.2	8.8	6.3
Newspapers	4.8	3.0	0.4	8.3	4.4	3.1
Books and Magazines	6.1	3.9	1.1	18.0	5.0	3.6
Office Papers	3.7	2.3	0.5	13.5	3.2	2.3
Commercial Printing	8.5	5.4	0.2	2.4	8.3	5.9
Other Nonpackaging Paper	5.8	3.7	0.0	0.0	5.8	4.1
Other Miscellaneous Nondurables						
TOTAL NONDURABLE GOODS	41.5	26.3	6.0	14.5	35.5	25.2
CONTAINERS AND PACKAGING						
Glass Containers	5.5	3.5	1.1	20.0	4.4	3.1
Beer & Soft Drink	6.3	4.0	Neg.	0.0	6.3	4.5
Other Glass Containers	11.8	7.5	1.1	9.3	10.7	7.6
Subtotal - Glass						
Steel Containers	0.1	0.1	0.0	0.0	0.1	0.1
Beer & Soft Drink Cans	1.8	1.1	0.1	5.6	1.7	1.2
Food Cans	0.9	0.6	Neg.	0.0	0.9	0.6
Other Steel Packaging	2.8	1.8	0.1	3.6	2.7	1.9
Subtotal - Steel						
Aluminum	1.3	0.8	0.6	46.2	0.7	0.5
Beer and Soft Drink Cans	0.4	0.3	Neg.	0.0	0.4	0.3
Other Aluminum Packaging	1.7	1.1	0.6	35.3	1.0	0.7
Subtotal - Aluminum						
Paper and Paperboard	19.4	12.3	8.0	41.2	11.4	8.1
Corrugated Containers	5.4	3.4	0.3	5.6	5.1	3.6
Other Paperboard	4.2	2.7	0.3	7.1	3.9	2.8
Paper Packaging	29.0	18.4	8.6	29.7	20.4	14.5
Subtotal - Paper						
Plastics	2.9	1.8	0.1	3.4	2.8	2.0
Plastic Containers	2.8	1.8	Neg.	0.0	2.8	2.0
Other Plastic Packaging	5.7	3.6	0.1	1.8	5.6	4.0
Subtotal - Plastics						
Wood Packaging	2.1	1.3	Neg.	0.0	2.1	1.5
Other Miscellaneous Packaging	0.2	0.1	Neg.	0.0	0.2	0.1
TOTAL CONTAINERS AND PACKAGING	53.3	33.8	10.6	19.9	42.7	30.3
TOTAL NONFOOD PRODUCT WASTE	114.3	72.5	17.0	14.9	97.4	69.2
OTHER WASTES*						
Food Wastes	12.5	7.9	Neg.	0.0	12.5	8.9
Yard Wastes	28.3	17.9	Neg.	0.0	28.3	20.1
Miscellaneous Inorganic Wastes	2.6	1.6	Neg.	0.0	2.6	1.8
GRAND TOTAL	157.7	100.0	17.0	10.8	140.8	100.0

* Some of these wastes are composted or otherwise recovered, but this is not estimated here.
** Discards after materials recovery and before energy recovery.

Neg. = Less than 100,000 tons.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Corrugated containers represent the largest tonnage of products recovered--8 million tons, or 41 percent of gross discards (Table 8). The second highest recovered tonnage in 1986 was newspapers, at 3.8 million tons recovered, or 30 percent of gross discards. Recovery of the two paper products--corrugated containers and newspapers--makes up almost 70 percent of the total estimated materials recovery in 1986.

Discards by Individuals

Per capita gross discards, materials recovery, and net discards were shown in Table 6. Net discards by individuals, broken down by materials category, are shown in Table 9. Only paper and paperboard and plastics have exhibited consistent growth in per capita discards. (Paper and paperboard do, however, drop in recession years.) Per capita net discards of the other materials in the waste stream have been rather flat or even falling slowly. This demonstrates the shift in materials use from relatively heavy metals and glass to relatively light paper and plastics.

Organics/Inorganics

The mix of organic and inorganic materials in the municipal waste stream is of interest to persons dealing with waste disposal, whether by sanitary landfill or by incineration with energy recovery. In the former case, organics decompose into residue and gases. In the latter instance, the organics are the fuel for combustion, while the inorganics become residue to be disposed.

Table 10 and Figure 6 illustrate the percentage breakdown of wastes discarded after materials recovery has taken place, but before energy recovery. There has been an uneven but noticeable trend toward an increased percentage of organic materials in the waste stream, from 77.8 percent in 1960 to 82.5 percent in 2000. This can be attributed to the increasing percentages of paper and plastics in the waste stream, and is occurring in spite of decreasing percentages of food and yard wastes in discards.

Paper has the highest tonnage of any organic constituent in the waste stream. Yard wastes and food wastes also contribute large tonnages. Plastics come next in order of tonnage contributed, with rubber, leather, textiles, and wood also in this category.

HOW THIS DATA SERIES DIFFERS FROM THE PREVIOUS ESTIMATES

The estimates of product wastes have changed very little since the last report was published in 1986. Some minor changes have been made to reflect revisions in data series, but these generally do not show up when the tonnage is rounded to millions.

Table 9

DISCARDS OF MUNICIPAL SOLID WASTE BY INDIVIDUALS, 1960 TO 2000
(In pounds per person per day)

Materials	1960	1965	1970	1975	1980	1981	1982	1983	1984	1985	1986	1990	1995	2000
Paper and Paperboard	0.74	0.91	0.98	0.87	1.01	1.04	0.98	1.07	1.14	1.12	1.14	1.20	1.27	1.35
Glass	0.19	0.24	0.33	0.33	0.34	0.34	0.33	0.31	0.30	0.28	0.27	0.27	0.26	0.25
Metals	0.32	0.30	0.36	0.34	0.31	0.31	0.30	0.30	0.30	0.28	0.29	0.29	0.30	0.29
Plastics	0.01	0.04	0.08	0.11	0.18	0.19	0.20	0.21	0.22	0.22	0.23	0.26	0.29	0.32
Rubber and Leather	0.05	0.06	0.08	0.09	0.10	0.10	0.09	0.08	0.08	0.08	0.09	0.08	0.08	0.08
Textiles	0.05	0.05	0.05	0.06	0.06	0.08	0.07	0.07	0.06	0.06	0.06	0.07	0.07	0.07
Wood	0.09	0.10	0.11	0.11	0.12	0.10	0.12	0.12	0.12	0.12	0.13	0.12	0.12	0.12
Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL NONFOOD PRODUCTS	1.46	1.71	2.00	1.92	2.13	2.16	2.07	2.16	2.22	2.16	2.21	2.29	2.37	2.48
Food Wastes	0.37	0.35	0.34	0.34	0.29	0.29	0.28	0.28	0.28	0.28	0.28	0.27	0.26	0.25
Yard Wastes	0.61	0.61	0.62	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.65	0.65	0.65
Miscellaneous Inorganics Wastes	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.07
TOTAL WASTES DISCARDED*	2.48	2.71	3.01	2.95	3.11	3.13	3.04	3.14	3.20	3.14	3.19	3.27	3.35	3.45
ENERGY RECOVERY**	0.00	0.01	0.01	0.02	0.06	0.05	0.08	0.12	0.15	0.17	0.22	0.29	0.47	0.65
NET WASTES DISCARDED	2.48	2.70	3.00	2.93	3.04	3.08	2.96	3.03	3.05	2.97	2.98	2.98	2.88	2.80

* Wastes discarded after materials recovery has taken place.
** Municipal solid waste consumed for energy recovery. Does not include residues.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

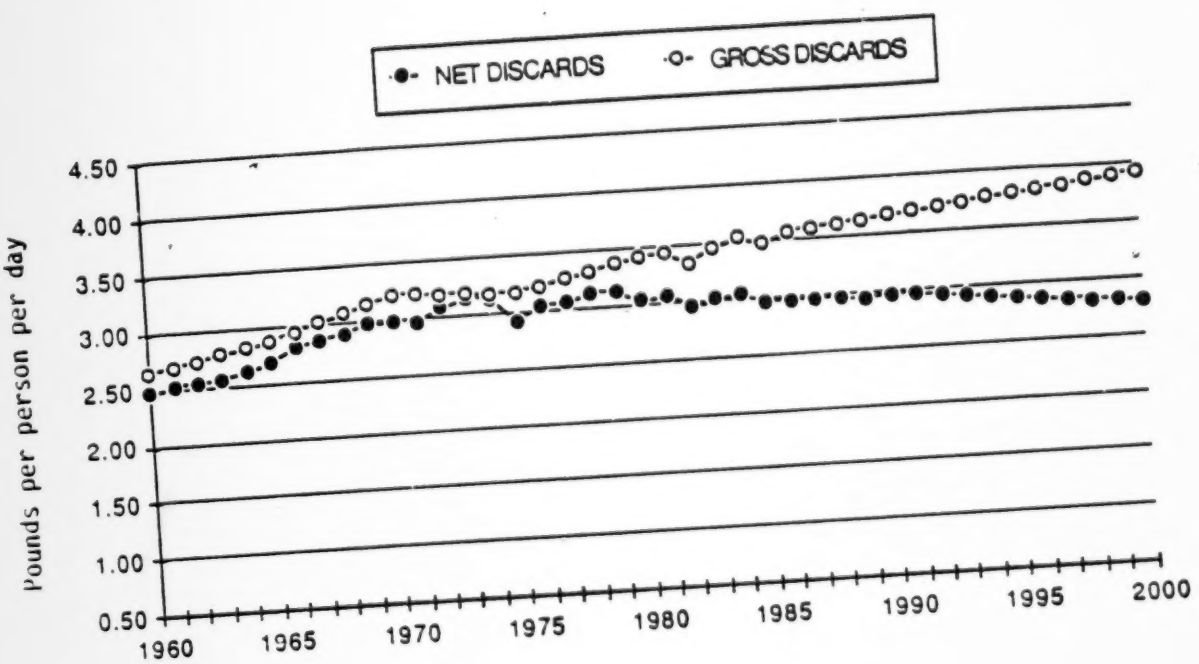

Figure 5. Gross discards and net discards (after materials and energy recovery) of municipal solid waste, in pounds per person per day, 1960 to 2000.

Table 10

COMPOSITION OF MUNICIPAL SOLID WASTE DISCARDS*
BY ORGANIC AND INORGANIC FRACTIONS, 1960 TO 2000
(In percent of total net discards)

Year	Organics	Inorganics
1960	77.8	22.3
1965	78.3	21.7
1970	75.2	24.8
1975	75.5	24.5
1980	77.1	22.9
1981	77.5	22.5
1982	77.8	22.2
1983	78.7	21.3
1984	79.6	20.4
1985	80.4	19.6
1986	80.8	19.2
1990	80.8	19.2
1995	81.7	18.3
2000	82.5	17.5

* Discards after materials recovery has taken place, and before energy recovery.

Source: Franklin Associates, Ltd.

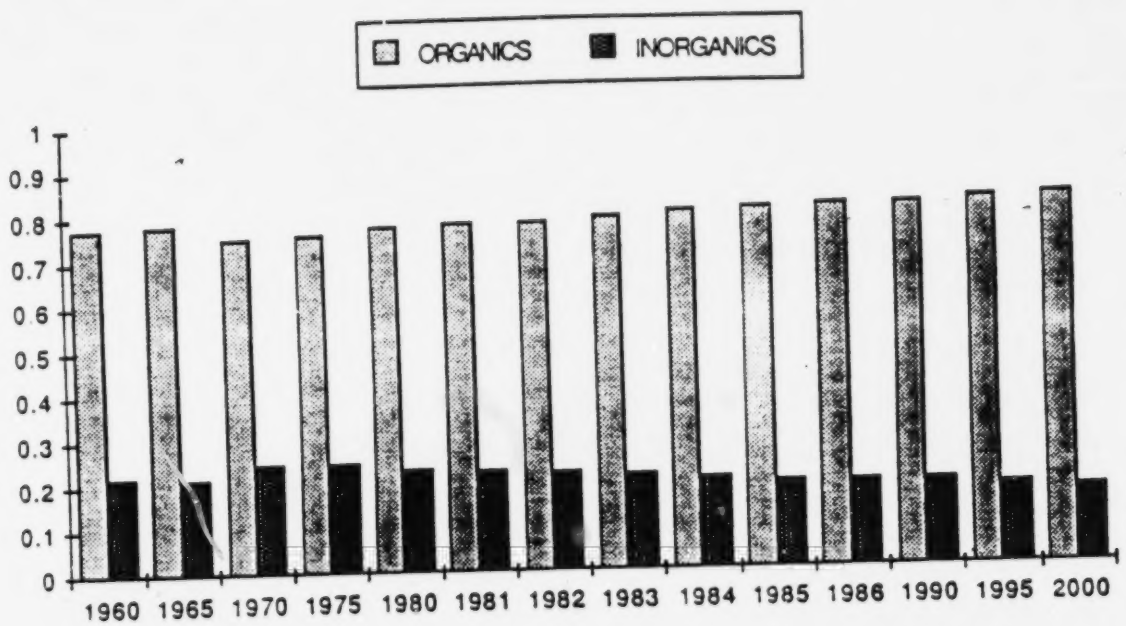

Figure 6. Composition of municipal solid waste by organic and inorganic fractions, 1960 to 2000.

Estimates of food and yard wastes have, however, been revised again. These estimates are based on sampling data and are thus much more difficult to determine accurately. The 1986 estimates, which also were based on sampling data, did not allow for moisture lost from food and yard wastes when mixed with other wastes, which would occur before sampling took place. Since the estimates of product wastes are made on an "as-generated" basis, the food and yard wastes should have been adjusted upward so that they also were on an "as-generated" basis. This has been done for the revised data series in this report.

A comparison of the two estimates for 1984 is shown in Table 11. The overall effect for 1984 is to increase the weight of total net discards by 4 percent. Adjustments for the other years in the series are similar.

Table 11

COMPARISON OF 1984 DISCARDS ESTIMATED IN 1986 AND 1988
(In millions of tons and percent)

Materials	1986 Estimate	1988 Estimate	% Difference
Paper and Paperboard	49.4	49.4	-
Glass	12.9	12.8	-1.0
Metals			
Ferrous	11.0	11.0	-
Aluminum	1.5	1.5	-
Other Nonferrous	0.3	0.3	-
Plastics	9.6	9.6	-
Rubber and Leather	3.3	3.3	-
Textiles	2.8	2.8	-
Wood	5.1	5.1	-
TOTAL NONFOOD PRODUCT WASTE	96.0	95.9	-
Food Wastes	10.8	12.2	+13.0
Yard Wastes	23.8	27.8	+16.8
Miscellaneous Inorganic Wastes	2.4	2.4	-
TOTAL WASTES DISCARDED*	133.0	138.3	+4.0

* Waste discarded after materials recovery, and before energy recovery.

Source: Franklin Associates, Ltd.

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